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(54) A doctor blade and a method of fastening the same on pulp or papermaking machine doctors.

(57) A doctor blade (20) is made from an elongated strip (22) of reinforced composite material which material fibrillates when cut. A plurality of cuts (34, 36) are made in the material which form recesses (30). The recesses are offset to increase the effective thickness of the strip so that it can be inserted longitudinally or transversely into a doctor blade holder (50). The fibrillations maintain the recesses in an offset position.

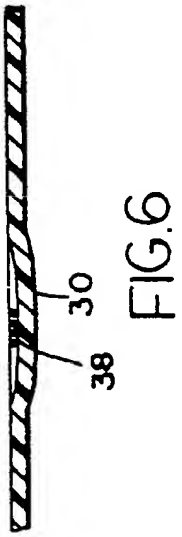

FIG.6

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This invention pertains to a blade used on a doctor for a pulp or papermaking machine, and more particularly to a blade made of plastics material, such as, for example, a fiber reinforced composite material.

Pulp or papermaking machines utilize machine rolls. Such machine rolls are used during various aspects of the process, for example, in the forming, pressing, drying or calendering sections. The operation of machine rolls requires a device to remove contaminants which form on the roll surface and/or to peel off a sheet or web from the rolls. A traditional method of achieving this is through the use of a mechanical device commonly referred to as a doctor or doctor blade. The failure to remove the contaminants or the sheet effectively can have a catastrophic effect on the quality of the product being produced.

The doctor blade is typically fastened to a structural beam which is adjustably supported across the papermaking machine, on which beam a blade holder and a replaceable blade is provided. The doctor blade comes in direct contact with the roll surface so as to scrape off any contaminants from the roll surface, or to scrape off the whole pulp or paper web sheet, or parts thereof.

There is a plurality of different doctor blade types having dimensions and materials commonly available in the industry, as well as different designs of blade holders. Laminated plastics doctor blades and blade holders such as type KF-35, KF-35A or PNEUFLEX blade holder are manufactured by Albany International Corp.. For obvious reasons the blade should be securely attached to the blade holder as a doctor without a blade will not scrape anything from the roll, and as aforesaid, this will have a catastrophic effect on the machine production. But even worse, the blade or a part thereof can come off and fall in the machine and may irreparably damage the pulp or paper machine clothing; the roll may also be damaged because of direct and sudden contact with the blade holder.

The ultimate solution to prevent the aforesaid catastrophic situation would be to permanently fasten the blade to the holder or to make it as an integral part of the holder. But, doctor blades do wear with time. Depending on the application, they can last anywhere from a few hours to several months. Therefore, a doctor blade must be a replaceable item. The blade and holder design should allow for easy, fast and safe blade replacement so as to ensure that neither the blade, nor a part thereof, like the fastening devices for example, will come off and fall into the machine.

A common design in the industry is to put along one edge of the blade some types of rivets, or sore other mechanical retainers that could be, for example, rivetted, glued or press-fitted to the blade. The holder is then manufactured with a slot incorporating a step or a groove. The edge of the blade with the retainers can be slid into the groove through one end of the holder. Alternative designs are also available which allow a blade to be removed from the front of the holder, for the few applications where the access through the ends is limited. However, all these designs although widely used in the industry have a significant drawback as very often a retainer will come off the blade, and will either fall into the machine, or will stay in the holder but become wedged into the blade slot, thus making the blade very difficult to slide in or out.

Another design used in the industry consists of making the blade with built-in retainers whereby there is no mechanically fastened part on the blade that can come off. One known way to do this is to machine the blade out of thicker material, leaving a narrow step along one edge that will retain the blade in the holder slot. This method is widely used to manufacture polyethylene doctor blades, where machining is fast and easy, and where thicker material is also required to add strength or to increase wear life. Theoretically, this method can be used to manufacture blades out of other popular materials, like metal or laminated plastics. However, the increase in cost of the material and in machining time, colined with the high amount of tooling required, render this method simply undesirable. Moreover, it would not be suitable for the front removable blade design.

Another known way of making built-in retainers on the doctor blade is to stamp or punch pairs of short recesses along one edge of the blade at a certain spacing, to simulate the function of the rivets of the first design. A typical drawing of the industry standard is shown in Figures 1 and 2. However, this design has been used only to manufacture metallic doctor blades, such as bronze or stainless steel for example. It was believed that the mechanical properties of synthetic material used in the doctor blade industry, such as, for example, those of laminated glass fiber reinforced plastics, did not allow this method to be used on plastics blades. All the laminated composite doctor blades known to be used on the pulp or paper machines today, are manufactured with add-on retainers that are either rivetted, glued, or press-fitted along one edge of the blade, a design with major disadvantages as described above. One such prior art rivetted composite doctor blade is shown in Figure 3.

One objective of the present invention is to provide a plastics doctor blade with built-in retainers, thereby offering all the advantages relating to this design yet cost effective to manufacture.

The present invention provides a doctor blade comprising an elongate strip of plastics material having a plurality of recess means formed on said strip to extend the effective thickness of said blade, each recess means being formed by a section of material disposed adjacent one or more cuts in the strip and maintained in a position offset therefrom by protrusions disposed along the cutting line. The protrusions may be formed by the act of shearing the material

along the cutting line.

The strip is preferably formed of a plastics composite material, ideally a reinforced composite material. The plastics material may be reinforced with fiberglass fibers. One especially preferred material is a laminated vinyl ester.

The strip by have first and second opposed surfaces, and said recess means may protrude above one of said surfaces. The recess means may be partitioned into a first group protruding above said first surface, and a second group protruding below said second surface. Preferably, the arrangement of the recess means is such that the recess means of the first group alternate with the recess means of said second group.

The recess means may comprise a strap of the same material as said strip. The strap may be formed by a pair of parallel cuts in said strip, the interfacing surfaces of each cut having protrusions which maintain said strap laterally offset from said strip.

The present invention also provides a doctor blade assembly comprising a doctor blade as specified above, and doctor blade holder means comprising elongate means and a longitudinal cavity for receiving the recess means. The assembly preferably comprises a doctor blade formed of an elongate strip made of a reinforced composite plastics material, said blade having first and second opposed sides, and a plurality of recess means formed near one of said sides to increase the effective thickness of said blade, said blade being coupled to said holder means with said recess means being disposed inside the cavity, said cavity and said recess means co-operating to capture said blade. The cavity may comprise a single, longitudinal channel into which snid blade is insertable longitudinally. Alternatively, the bolder means may include a plurality of fingers and said cavity may be defined by cavity longitudinal channels in the fingers, said blade being insertable transversely between said fingers. Advantageously, the assembly further comprises securing means for securing said blade to said holder means.

The present invention further provides a method of making a doctor blade assembly comprising providing an elongate, generally rectangular strip of said plastics material and forming a plurality of recess means in said strip by making cuts in said strip and offsetting a section of material adjacent said cuts to increase the effective thickness of said strip, said sections having a length selected to deform said sections elastically.

A blade may be made by taking an elongated strip of reinforced composite material and punching a plurality of elongated recesses adjacent to a longitudinal side of the material. The recesses are formed by making cuts which are made long enough so that the plastic or permanent deformation of the material in the region around each recess is avoided. The cuts are made by a method which fibrillates the material along the plane of the cut so that irregularities are formed in the material along the cut which prevent the recessed material from returning to a normal position.

The method may further comprise providing a blade holder means, as specified above, and inserting said doctor blade into said cavity.

The present invention also provides a method of securing a doctor blade made of a reinforced composite material to a blade holder, said blade holder including a longitudinal cavity, said method comprising the steps of providing an elongated, generally rectangular strip of said reinforced plastic material having at least one longitudinal side, forming a plurality of recesses in said strip along said one side by making cuts in said strip and offsetting a section of material adjacent said cuts to increase the effective thickness of said strip, said sections having a length selected to deform said sections elastically, to form a doctor blade, and, inserting said doctor blade into said cavity, said cavity and said straps co-operating to hold said blade. The said section may be formed between two interface surfaces with protrusions, said protrusions co-operating to maintain said sections in an offset position.

By way of example, prior art doctor blades and various embodiments of the invention will now be described with reference to the accompanying drawings, of which.

Figure 1 shows a plan view of a prior art metallic doctor blade discussed above;

Figure 2 shows a partial side view of the prior art doctor blade, to a larger scale than that of Figure 1;

Figure 3 shows an end view of a rivetted plastics prior art doctor blade;

Figure 4 shows a plan view of a plastics laminated doctor blade constructed in accordance with this invention;

Figures 4A and 4B show, respectively, a partial plan view and an end view of the blade, to a larger scale than that of Figure 4;

Figure 5 shows a partial side view of the doctor blade, also to a larger scale than that of Figure 4;

Figure 6 shows a partial sectional view taken along line VI-VI in Figure 4, also to a larger scale than that of Figure 4;

Figure 7 shows the doctor blade inserted into a blade holder;

Figure 8 shows a side view of the doctor blade being inserted into the holder;

Figure 8A shows a modified arrangement of the holder and blade of Figure 8;

Figure 9 shows a front view of a punch-and-die assembly used to punch the recess in the blade of Figures 4-8;

Figure 10 shows an end view of the punch-and-die assembly of Figure 9;

Figure 11 shows a plan view of a second type of doctor blade;

Figure 12 shows a side view of the blade of Figure 11;

Figure 13 shows a plan view of a third type of doctor blade;

Figure 14 shows a blade holder for the blade of Figure 13; and,

Figure 15 shows a fourth type of doctor blade.

Referring to Figure 1 and 2, one known doctor blade 10 consists of an elongated strip 12 made of stainless steel, bronze, or other alloys. One longitudinal side 14 of strip 12 is bevelled to form an edge. Along the opposite side, strip 12 is provided with a plurality of short punchings 16 punched into the member 12. Preferably, punching 16 are formed in pairs as shown, and each punching is about 3/8" (9.5 mm) long. These punchings are made by permanently or plastically elongating and deforming the material of the strip to form the shown structure. This process could not easily be used on a reinforced composite blade because such a material is fragile and when punched is liable to break quickly.

Figure 3 showns another prior art doctor blade 18 made of a composite plastics material which at regular intervals is provided with a protruding rivet 19.

A doctor blade 20 constructed in accordance with the present invention and shown in Figures 4, 4A, 4B, 5 and 6 consists of a strip 22 made of a fiber reinforced laminated plastics material such as a plastics laminated base of, for example, a vinyl ester reinforced by fiberglass fibers. In a preferred embodiment of the invention, strip 22 is about 0.060" (1.5 mm) thick, and 3" (78 mm) wide. One side 24 of strip 22 is bevelled at an angle of about 45° to form a sharp doctoring edge 25. Adjacent to the other side 26 of the strip 22, there are a plurality of recesses 30 extending along the length of the strip. At least one end of the strip 22 is provided with a through hole 32 by which the strip can be grabbed so that it can be removed from a holder.

As shown in more detail in Figure 4A, each recess 30 is formed by making two parallel cuts 34, 36 in the strip 22. Because the strip is made of fiber glass reinforced composite material, as described above, the cuts 34, 36 are not perfectly planar, but are somewhat irregular with the inner surfaces of the cuts having a plurality of irregular fibrillations 38 (shown in Figure 6). (For the sake of clarity, in Figure 4A the irregularities of cuts 34 and 36 are shown somewhat exaggerated).

Preferably, simultaneously with the cutting, the strap 40 is pushed out laterally with respect to the strip 22 to form the corresponding recess. The length and spacing of the cuts 34, 36 and their distance from side 26 are selected to ensure that as the recess is formed the material around the cuts is deformed substantially, elastically, whereby the strip 22 is not permanently deformed. In this manner, the strap 40 is not broken off but remains attached to the strip at both ends to form the recesses. The strap 40 is retained in the position shown in Figure 6 by the interference created between the fibrillations on the surfaces formed by cuts 34, 36. Typically, each strap 40 may be, for example, about 1" (25 mm) long and 3/16" (4 mm) wide, and may be disposed at least 1/8" (3 mm) away from edge 26.

Referring now to Figures 7 and 8, a typical flexible doctor blade holder 50 consists of en elongated first member 52 secured to a frame (not shown). Several fingers 58 are equally spaced along first member 52 as shown. Each finger 58 includes a channel 66. After blade 20 is formed as described above with reference to Figures 4-6, it may be inserted into the holder by sliding it into cavity 62 in direction A, with recesses 30 sliding through channel 66. A sharp tool may be used to engage hole 32 to pull the blade into the holder. The holder is made to have dimensions just slightly larger than the blade whereby, once the blade is seated in its place it is maintained there by interference fit with the holder. Additionally a hole 70 may be made at the ends of the holder. After the blade is inserted a pin is then introduced through hole 70, and hole 32 in the blade, thereby securing the blade in place. In Figure 7 the blade is shown with edge 25 positioned for doctoring a roller 64.

The fingers 58 are spaced at a preselected distance of, for instance, 2 inches (5 cm). For the embodiment of Figure 8, in order to ensure that at least some of the recesses 30 are captured between the fingers 50 and member 52, they are spaced at odd intervals, i.e. at intervals of an odd number of inches.

In the preferred embodiment of Figure 8A, the blade 20 is not inserted longitudinally. Instead the blade 20 is first positioned so each recess 30 is disposed between two fingers 50 and the blade is advanced laterally between plate 52 and fingers 50. The blade is then moved longitudinally, as indicated by arrow B until the recesses 30 are captured within channels 66 of fingers 58 and member 52. For this embodiment the recesses 30 must be spaced evenly with the spacing of the fingers 58. The blade may now be secured as described above. This embodiment is used in environments where there is insufficient lateral space to slide the blade longitudinally into the holder.

Figures 9 and 10 show a punch-and-die assembly 80 which may be used to make the recesses 30 in a strip 22. The assembly 80 includes a table 82 with two vertical uprights 84, 86. On table 82 there is a blade holder 88 for holding a blade 22. A lip 90 on holder 88 helps position the strip 22. The holder also has an arcuate depression 92 positioned at a distance from lip 90 to define the position and dimensions of the recesses. Above the table 82 there is a member 94 movable vertically on the uprights 84, 86 as shown. This member 94 has a lower extension 96 disposed

exactly above depression 92 and dimensioned to be complementary in size and shape to the depression. Thus, without the strip 22, when the member 94 lowered on the holder 88, extension 96 fits snugly into depression 92.

The operation of assembly 80 is obvious from the above description. The strip 22 is first placed on holder 88 and then the member is forcefully lowered or dropped onto the strip 22. The shear formed at the interface between extension 96 and depression 92 generates the cuts 34, 36 and strap 40, and extension 96 pushes the strap 40 down to deform it elastically to form a recess. After each recess is made the strip is repositioned for the next recess by shifting it laterally. Alternatively the assembly 80 may be modified to make all the recesses simultaneously. Of course, other devices may be used to make the recesses as well.

An alternative embodiment of the invention is shown in Figures 11 and 12. In these Figures, strip 100 is made with two sets of recesses 102, 104, the difference between the two sets being that while recesses 102 are punched from the bottom, recesses 104 are punched from the top of strip 100 as shown. tn the embodiment of Figures 11 and 12 the recesses 102, 104 are in line.

A further embodiment of the invention is shown in Figure 13 herein strip 110 is also formed with two sets of recesses 112, 114. However in this latter embodiment recesses 112 are laterally offset from recesses 114. A holder 116 for a doctor blade made like strip 110 is shown in Figure 14. In this Figure, the holder 116 is made with a much wider channel 118 to accommodate both recesses 112, and 114 as shown.

Finally, the recesses may be forced by means other than two parallel cuts. For example as shown in the embodiment of Figure 15, a blade 120 may be made with recesses 124 formed by a single curve, dimensioned and shaped to cut out sufficient material to allow elastic deformation. As previously described, the recess will hold in place because of the fibrillation of the material along the curved cut.

Claims

1. A doctor blade comprising an elongate strip of plastics material having a plurality of recess means formed on said strip to extend the effective thickness of said blade, each recess means being formed by a section of material disposed adjacent one or more cuts in the strip and maintained in a position offset therefrom by protrusions disposed atong the cutting line.

2. A doctor blade as claimed in claim 1, wherein said material is a plastics composite material.

3. A doctor blade as claimed in claim 1 or claim 2, wherein said strip has first and second opposed surfaces, and said recess means protrudes above one of said surfaces.

4. A doctor blade as claimed in claim 3, wherein said plurality of recess means are partitioned into a first group protruding above said first surface, and a second group protruding below said second surface.

5. A doctor blade as claimed in claim 4, wherein the recess means of said first group alternate with the recess means of said second group.

6. A doctor blade as claimed in any one of the preceding claims, wherein each recess means comprises a strap formed by a pair of parallel cuts in said strip, the interfacing surfaces of each cut having protrusions which maintain said strap laterally offset from said strip.

7. A doctor blade assembly comprising a doctor blade as claimed in any one of the preceding claims, and doctor blade holder means comprising elongate means and a longitudinal cavity for receiving the recess means, the assembly preferably comprising a doctor blade formed of an elongate strip made of a reinforced composite plastics material, said blade having first and second opposed sides, and a plurality of recess means formed near one of said sides to increase the effective tickness of said blade, said blade being coupled to said holder means with said recess means being disposed inside the cavity, said cavity and said recess means co-operating to capture said blade.

8. A doctor blade assembly as claimed in claim 7, wherein the cavity comprises a single, longitudinal channel into which said blade is insertable longitudinally.

9. A doctor blade assembly as claimed in claim 7, wherein said holder means includes a plurality of fingers and said cavity is defined by cavity longitudinal channels in the fingers, said blade being insertable transversely between said fingers.

10. A doctor blade assembly as claimed in any one of claims 7 to 9, further comprising securing means for securing said blade to said holder means.

11. A method of making a doctor blade assembly comprising providing an elongate, generally rectangular strip of said plastics material and forming a plurality of recess means in said strip by making cuts in said strip and offsetting a section of ma-

terial adjacent said cuts to increase the effective thickness of said strip, said sections having a tength selected to deform said sections elastically.

12. A method as claimed in claim 11, further comprising providing blade holder means as specified in any one of claims 7 to 9 and inserting said doctor blade into said cavity.

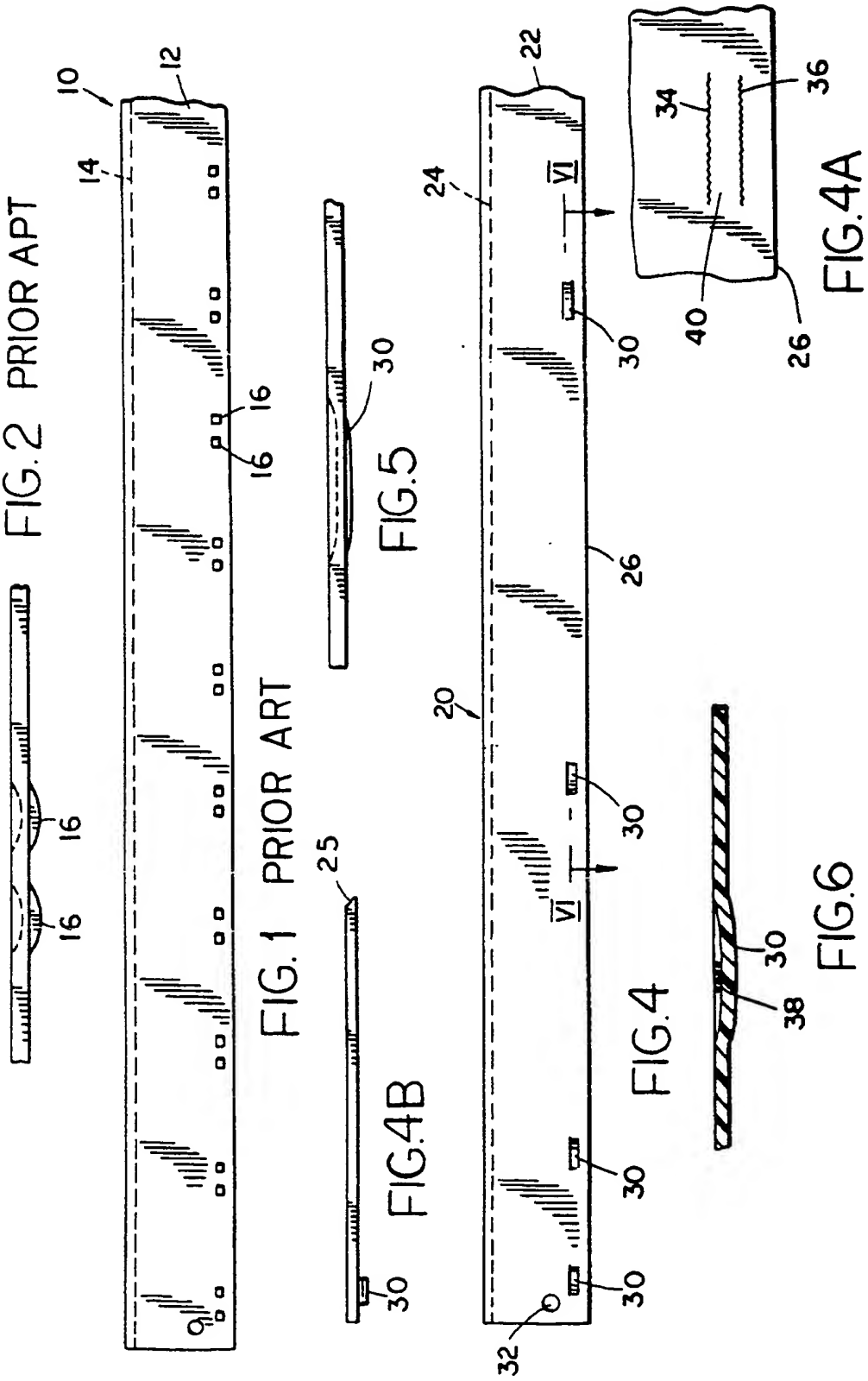


FIG.1 PRIOR ART

FIG.2 PRIOR APT

FIG.4B

FIG.5

FIG.4

FIG.4A

FIG.6

FIG. 3 PRIOR ART

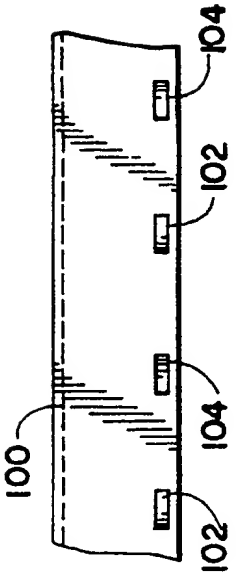


FIG. 11

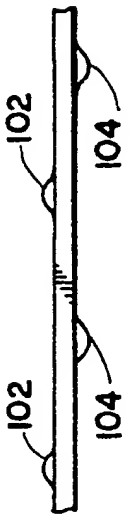


FIG. 12

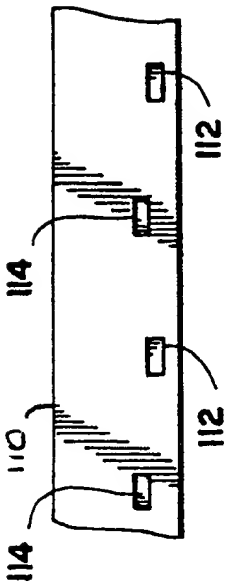


FIG. 13

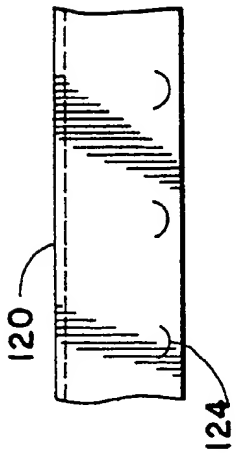


FIG. 15

FIG. 7

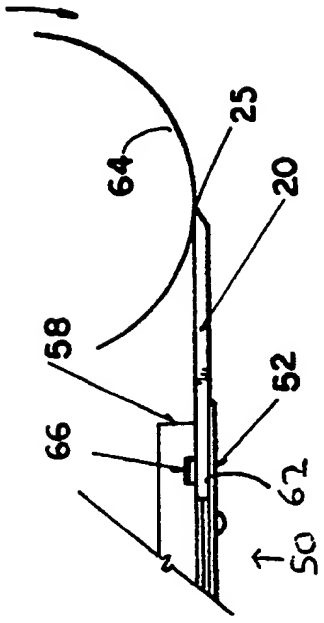


FIG. 8

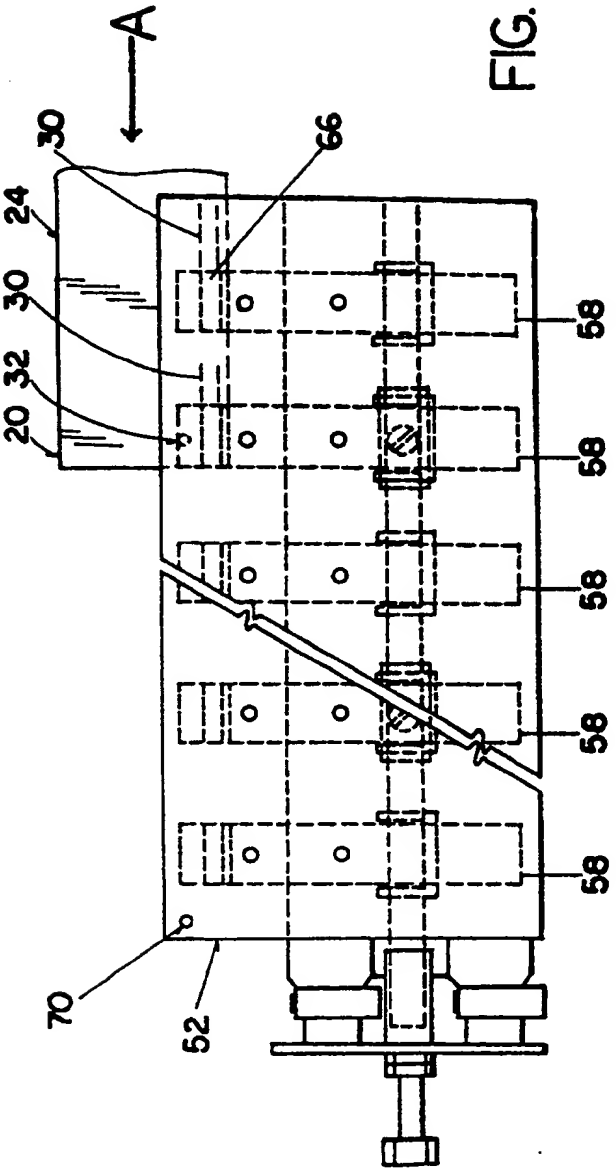


FIG. 14

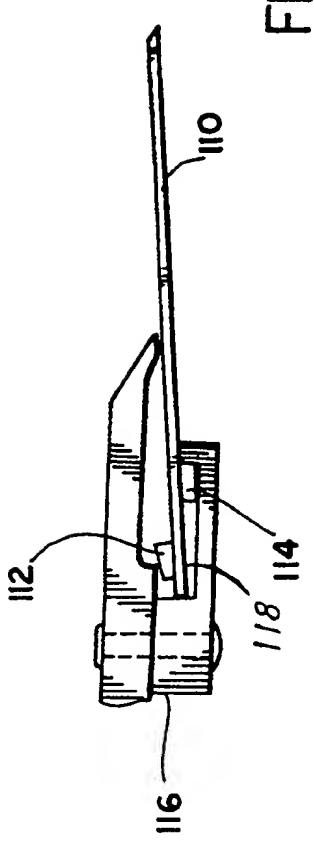


FIG. 8A

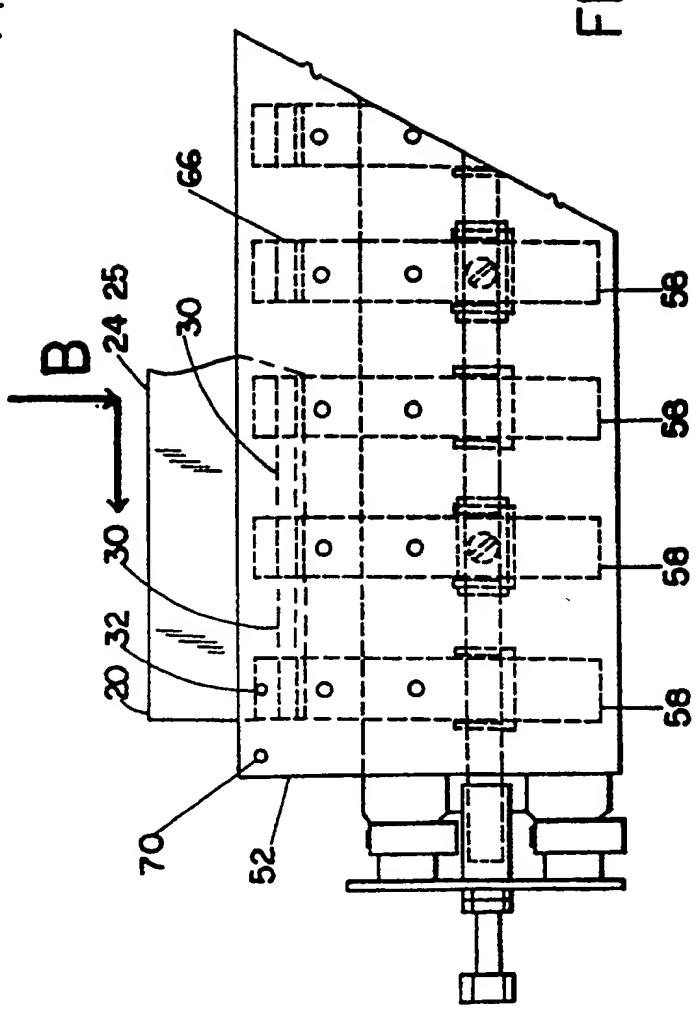
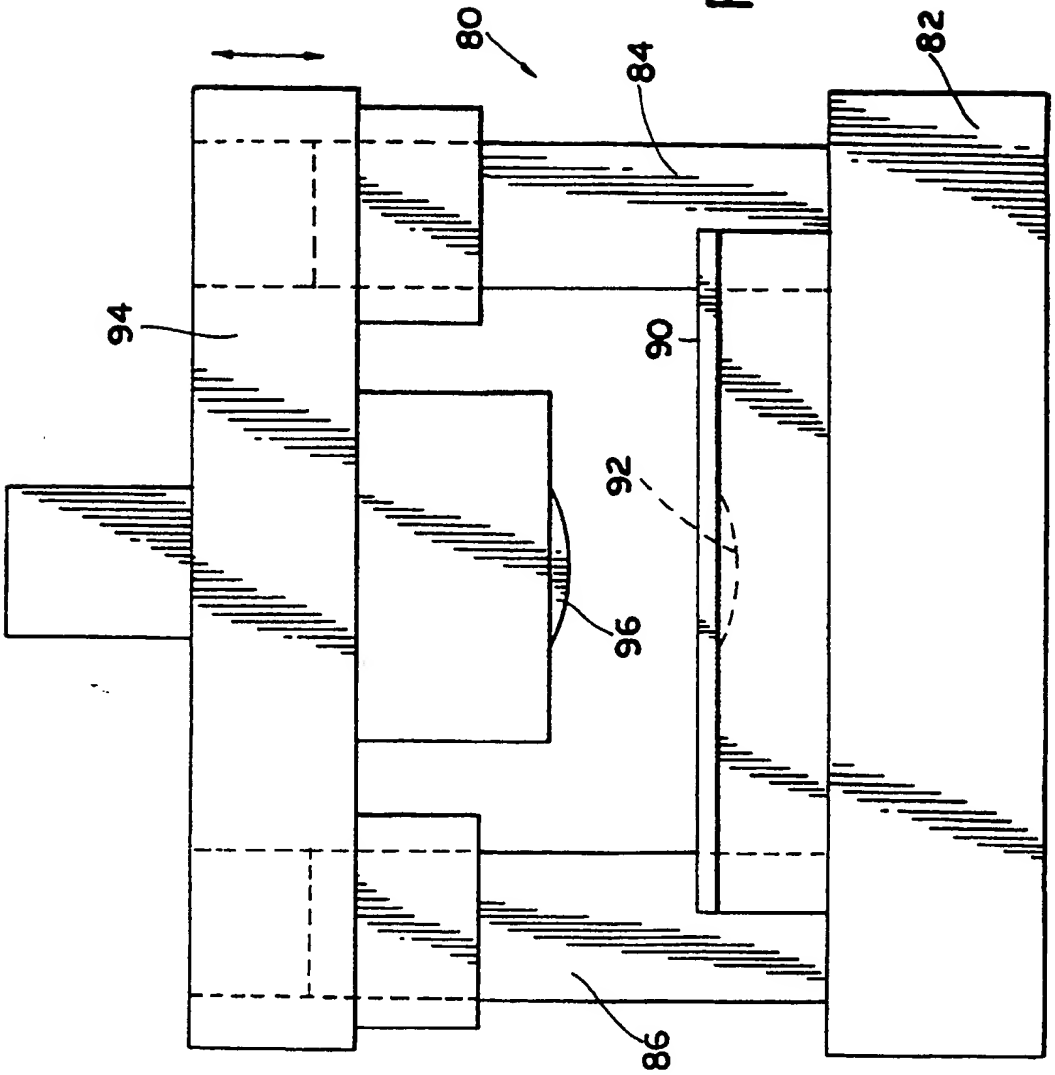


FIG.9



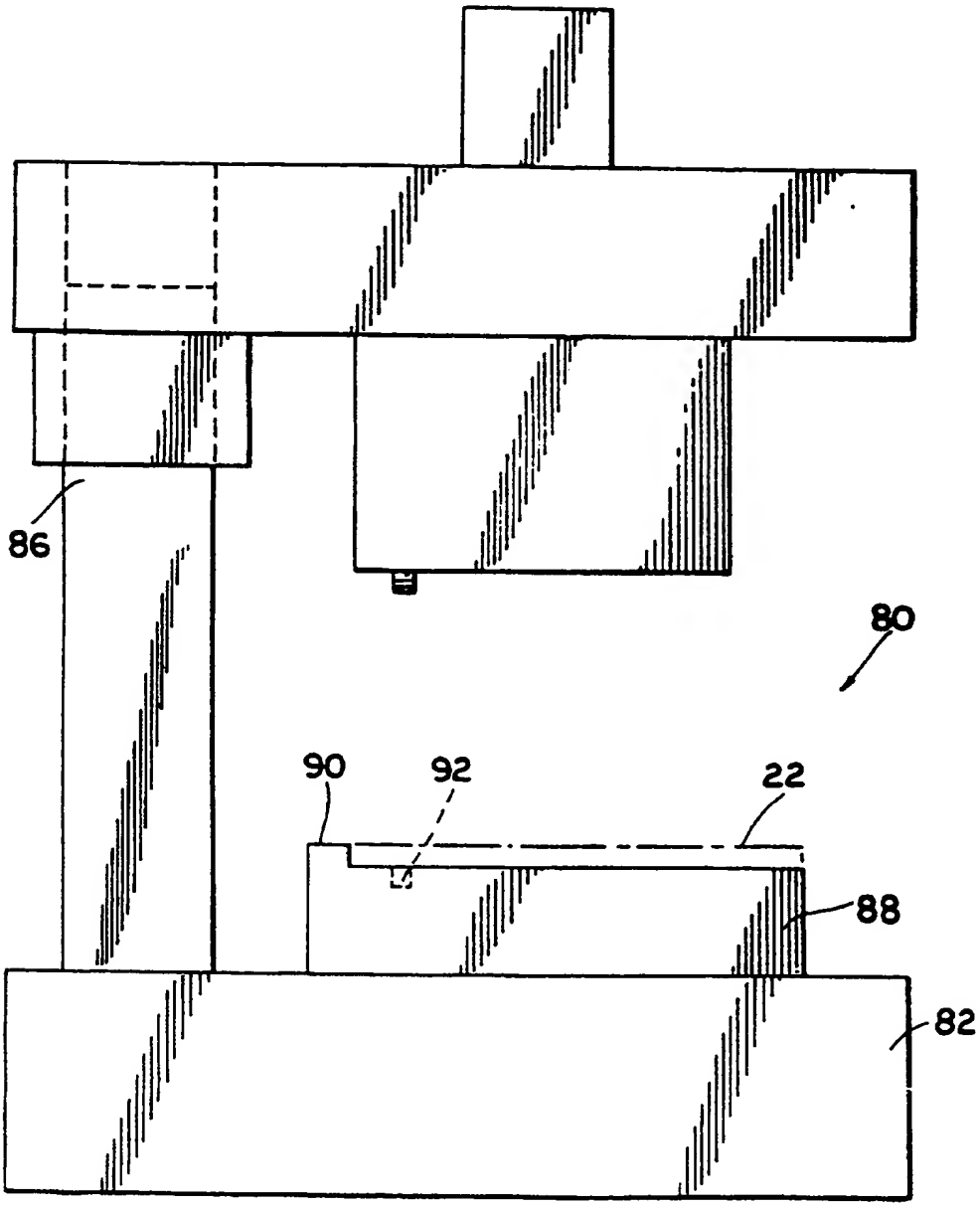


FIG. 10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 30 3609

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	DE-B-1 055 351 (VICKERYS)		D21G3/00
A	BE-A-625 872 (D.S.T.PATTERN AND ENGINEERING CIE)		
A	US-A-4 549 933 (JUDD ET AL)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D21G
B41F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	09 AUGUST 1991	DE RIJCK

CATEGORY OF CITED DOCUMENTS

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